Table 4.—*Comparison of wind force at continental and insular stations (Beaufort scale)*—Continued

	January	February	March	April	May	June	July	August	September	October	November	December	Year
Wenchow	1.4	.9	.9	2.4	2.0	.7	1.4	1.3	1.0	1.2	1.0	1.1	1.4
Peiyushan	4.2	3.9	3.2	2.6	2.6	2.3	2.8	2.7	3.1	3.5	3.3	3.7	3.2
Difference	−2.8	−3.0	−2.3	−.2	−.6	−1.6	−1.4	−1.4	−2.1	−2.3	−2.3	−2.6	−1.8
Pagoda Anchorage	1.4	1.4	1.4	1.2	1.4	1.3	1.6	1.6	1.6	1.8	1.8	1.7	1.5
Tung Yung	4.0	3.8	3.5	3.4	3.1	3.2	3.7	3.4	3.5	4.0	3.9	3.8	3.5
Difference	−2.6	−2.4	−2.1	−2.2	−1.7	−1.9	−2.1	−1.8	−1.9	−2.2	−2.1	−2.1	−2.0
Amoy	2.8	2.6	2.6	2.4	2.5	2.6	2.6	2.5	2.6	2.9	2.7	2.6	2.6
Chapel Island	4.2	4.0	3.6	2.8	2.9	2.8	2.4	2.4	3.3	4.5	4.2	4.0	3.5
Difference	−1.4	−1.4	−1.0	−.4	−.4	−.2	+.2	+.1	−.7	−1.6	−1.5	−1.4	−.9
Swatow	1.9	2.1	1.8	1.8	1.8	1.8	1.8	1.8	2.0	1.9	1.8	1.8	1.8
Lamocks	4.0	3.8	3.7	3.1	2.8	2.6	2.3	2.3	3.3	4.4	4.1	3.8	3.4
Difference	−2.1	−1.7	−1.9	−1.3	−1.0	−.8	−.5	−.5	−1.3	−2.5	−2.3	−2.0	−1.6

Table 5

Stations	Distance from the sea	Altitude	Winter	Spring	Summer	Autumn	Year
	km	*m*	*mm*	*mm*	*mm*	*mm*	*mm*
Dunkerque	0	7	110	96	147	188	541
Les Moeres	5	1	133	122	180	227	662
Bergues	10	7	143	124	178	228	673
Steene	10	8	150	114	164	215	643
Wormhoudt	20	17	150	128	192	249	719
Nordpeene	25	20	153	147	196	247	743

CLIMATE OF THE ROGUE RIVER VALLEY, OREG.

By Willis B. Merriam

[Department of Geography, University of Washington, Seattle, Wash., September 1936]

The Rogue River Valley represents an area of about 300 square miles, carved out of the Klamath Plateau of southwestern Oregon by the Rogue River and its major tributaries. The elevation of the arable valley floor ranges from slightly under 1,000 feet at Grants Pass to 2,000 feet in the upper Bear Creek Valley, southeast of Ashland. The region is surrounded on all sides by mountains that rise to elevations of from 4,000 to 7,000 feet.

The economic basis of the Rogue River valley consists largely of general farming of a rather intensive nature, some mining, and an increasing health resort and tourist business. Its agricultural specialization consists of pears; it is one of the largest three commercial pear-producing regions in the United States.

So much of the economic development of the valley depends upon its distinctive climatic conditions that a résumé of the climatological environment is prerequisite to an understanding of the region.

RAINFALL

Climatically the Rogue River Valley is located in the southern part of the north Pacific climatic province; that is, it represents the more arid phase of the Marine Temperate or West Coast Cyclonic type. The American Mediterranean lies to the south in central and southern California and the Arid Continental lies to the east in the lee of the Cascade Mountains. Because it is situated some 60 to 100 miles inland, with a mountain interval between the valley and the coast, certain characteristics of both a subtropical and a continental nature are in evidence. Many of the older homes in Medford and Ashland have palm trees in their yards. They are not too vigorous in appearance, to be sure, nevertheless palm and pine meet in the Rogue River Valley, and at least two pomegranate trees have weathered some 30 or 40 years in the town of Jacksonville.

The maximum rainfall occurs in winter when the mild, moisture-laden winds from the Pacific blow across the cooler lands. The annual precipitation may be as heavy as 40 to 80 inches in the surrounding mountains; but the fact that the agricultural sections in the valleys lie from 2,000 to 6,000 feet lower than the surrounding territory, places the entire region within the rain-shadow of the ranges, definitely reducing the amount of precipitation that might otherwise be expected, and resulting, in fact, in a dry valley island within the Klamath Plateau. Down in the valley proper the average annual rainfall runs from 25 to 30 inches near Grants Pass where a considerable orographic precipitation carried over from the coastal mountains is still in evidence, to around 15 at Medford, the center of the "island."

The minimum rainfall occurs in summer. Except for occasional light convectional showers July and August are practically rainless. There are several reasons for the summer drought conditions. During the summer months a dominant anticyclonic area, the Cape Mendocino high, lies off the coast in the north Pacific. Winds blowing outward on the eastern side of this high have little opportunity to take up moisture before reaching the coast. Furthermore, during the summer the land becomes warmer than the ocean. The winds tend to warm up as they progress over the land, increasing the vapor capacity, and hence they are drying winds rather than moisture-giving winds. This tendency is further aggravated by the fact that the valley areas receive a great deal of insolation as the sun blazes down through cloudless skies, causing temperature to soar during the day. The result is that the winds unduly increase in temperature as they progress through the valley. Although local convection must be great, thunderstorms are not common, as the Rogue River Valley appears to be dominated by the greater convectional low pressure of the central California valleys and the permanent summer LOW that lies over the arid southwest. The valley winds, in other words, are drawn southward and southeastward instead of being allowed to ascend over the area; furthermore, because of the relative dryness of the air, the convection that does occur does not carry it high enough to reach condensation temperatures.

TEMPERATURES

According to Ellsworth Huntington, a month is cooler than is ideal if its average temperature falls below 32° F.; and warmer than ideal if the temperature averages above 70°. The Rogue River Valley fits well into this optimum temperature range. The mean annual temperature for the valley proper ranges between 52° and 53°, with extremes at Medford, 110° and −10°, respectively. Zero temperatures are rare; and the mean for January, the coldest month of the year, is between 37° and 39°.

Summers are hot. The means for July and August range between 69° and 71°. However, the hottest spells usually last but a week or so; and although general high temperature prevails, the humidity is low and the sensible temperature is not excessive. It is only with the passing of a cyclonic storm, resulting in an increased humidity, that the temperature becomes in the least oppressive, and that condition lasts but a few hours. Because of the cloudless skies, which facilitate rapid radiation, and the nocturnal drainage of cooler mountain air into the valley basins, nights in summer are always cool. This coolness lasts well into the morning, until the regular winds spring up and solar heat warms up the passing air.

The combination of mild winters, frequent temperature changes, warm to hot days in summer, but delightfully cool evenings and nights, is undoubtedly conducive to a maximum of human energy, and the Rogue River Valley may be safely referred to as one of the most energizing geographic regions in North America.

WINDS

There are no really destructive winds or storms throughout the valley. However, strong steady winds along the Bear Creek Valley sometimes present minor problems. The prevailing winds are westerly. In winter they are dominantly cyclonic in nature; they impart a southerly component to the westerly winds during the cool season. Anticyclonic and solar controls are dominant during the summer. At this season of the year, the winds may gain considerable impetus as they blow outward from the Pacific anticyclone. In general they follow the direction of the valley, due largely to conditions of local topography. As they leave Ashland they proceed definitely south-southeast, drawn by the summer LOW of the arid southwest and by Sacramento Valley convection; this is evidenced by the fact that the hotter the day, the more steady and firm are the winds. In fact on a hot afternoon the winds are drawn southward from the Rogue River Valley with such force that they tax the capacity of a powerful car in pulling up the Siskiyou Mountains northbound. These summer afternoon winds are so important a factor locally that drivers and truckers who are familiar with conditions schedule their trips so that they will be southbound over the Siskiyous in the afternoons and northbound either in the evening or morning, to escape the strong head winds that must otherwise be encountered.

Grants Pass, lying in what might be termed the "wind shadow" of the coastal mountains, has the second lowest average wind velocity of any station in the United States. As one progresses eastward through the valley, however, the winds increase considerably in velocity. This increase, and a prevailing northwesterly direction, mean that young orchards need to be especially pruned and sometimes propped to prevent leeward leaning and excessive leeward development of the trees. The practice of establishing orchards in the lee of poplar or eucalyptus windbreaks, as is done in many prairie areas and in parts of California, offers a possible solution but as yet has not been utilized in the valley.

FROST HAZARD AND THE GROWING SEASON

In the spring of the year there is considerable frost hazard in many parts of the basin. During nights favorable for frosts, the winds die down altogether and the colder air from the highlands drains down into the valley bottoms. If the winds are associated with a passing cyclonic area, the humidity has a tendency to be somewhat higher and frost is not likely; but if the winds emanate from anticyclonic areas, the humidity is lowered and damaging frosts may occur.

As a rule it is only on the valley floor that serious injury may be caused by the low temperatures during the blooming period. Where there are slight elevations no frosts may occur, while serious injury may result only a few feet below. The hillsides surrounding the valley usually escape frosts altogether, once the normal spring season has arrived. The average variation in temperature in favor of the lands lying above the valley floor is from 5° to 6°, due to a marked inversion of the temperature gradient when cold dense air creeps in and lies in stagnant pools underneath the warmer air. P. J. O'Gara, a special weather observer, who studied the frost problem of the Rogue River Valley a number of years ago, recorded temperatures ranging as low as 23° to 25° on the ground and 32° to 35° 50 feet above. "There is at times", he reports, "a difference of 12 degrees or more between ground temperatures and 50 feet above the valley floor."

Because of this frost danger on the valley floor, most of the more recently established fruit orchards have been in along the detrital slopes where air drainage is better. Here is located the greatest orchard acreage at the present time, although several fine old orchards are still found in the lowlands. Eternal vigilance against spring frost is the price paid for these orchards, however. Without artificial protection the danger of injury by frost is greater in the lowlands of the Rogue River Valley than in most fruit growing sections of the country. This fact has caused the development of one of the best systems of orchard heating in use among fruit growers anywhere in the United States.

In spite of the early season frost hazard in certain well-spotted sections of the valley, the growing season is fairly long. The Umpqua mountains north of Grants Pass protect the region from cold north winds, and the Cascade Range stops cold easterly winds to a large extent. Ashland, Grants Pass, Jacksonville, Medford, and Talent all range from 160 to slightly in excess of 200 frost-free days. The average growing season for the valley is about 190 days.

RAINFALL VARIABILITY

One characteristic of the precipitation of this complex climatic region, and one which has played an important part in shaping the economic history of the Rogue River Valley, is its variability in amount, monthly and annually. In illustrating this time distribution, the precipitation record for Ashland has been used for the reason that Ashland has the longest record, some 54 years, plus a 12-year unofficial private record, and conditions here are typical of the entire valley. There is a noticeable difference in total precipitation from year to year. In 1907 the heaviest rainfall in the history of the station occurred, with a total of 28.87 inches. Two years previous to that record, the lowest amount was recorded, when but 11.99 inches fell during the entire year. Following the dryest year, 24.25 inches fell, more than double the amount of the previous year.

The monthly rainfall likewise shows this variability. In January of 1881 a total of 12.29 inches fell—more in 1 month than in the entire dry year previously mentioned. The driest January on record received but 0.47 inch. August, ordinarily a rainless month, has had up to 2.71 inches of rain. The November amounts range from a

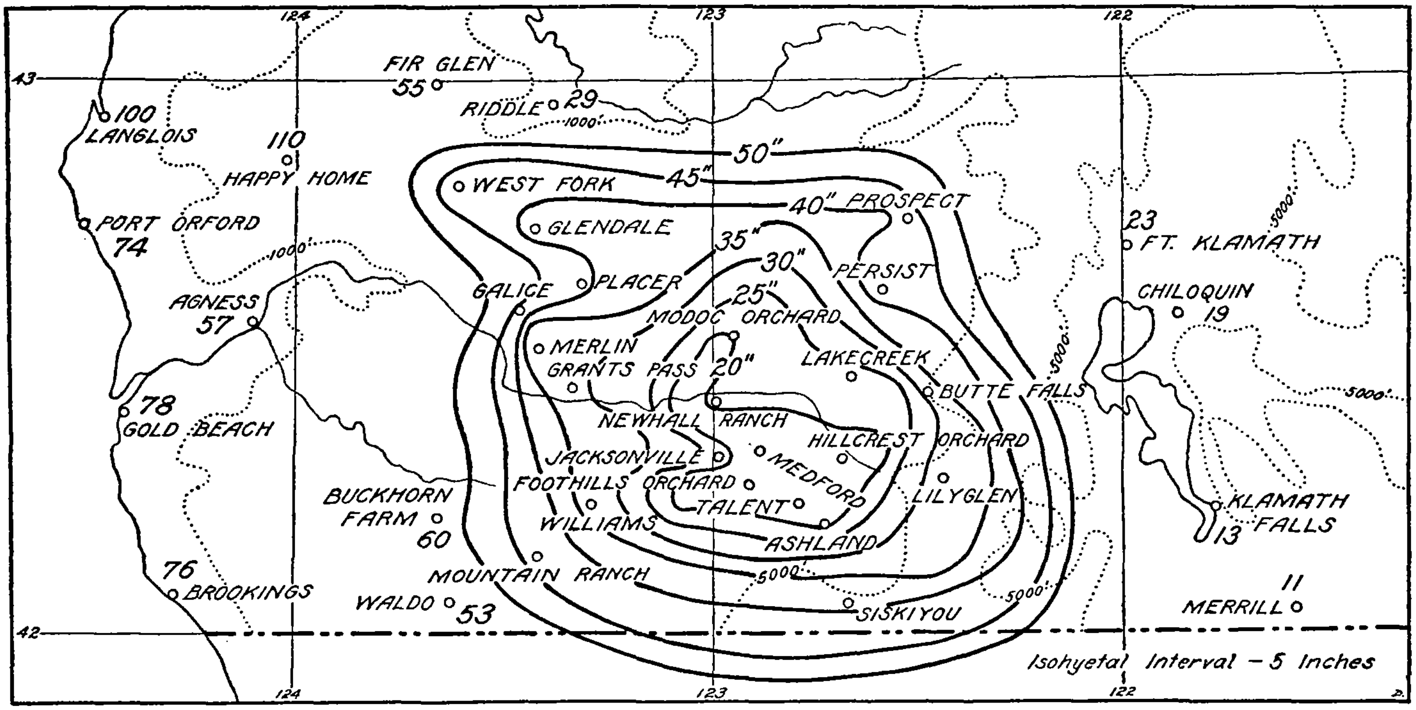

FIGURE 1.—Isohyetal map of Rogue River region, Oregon.

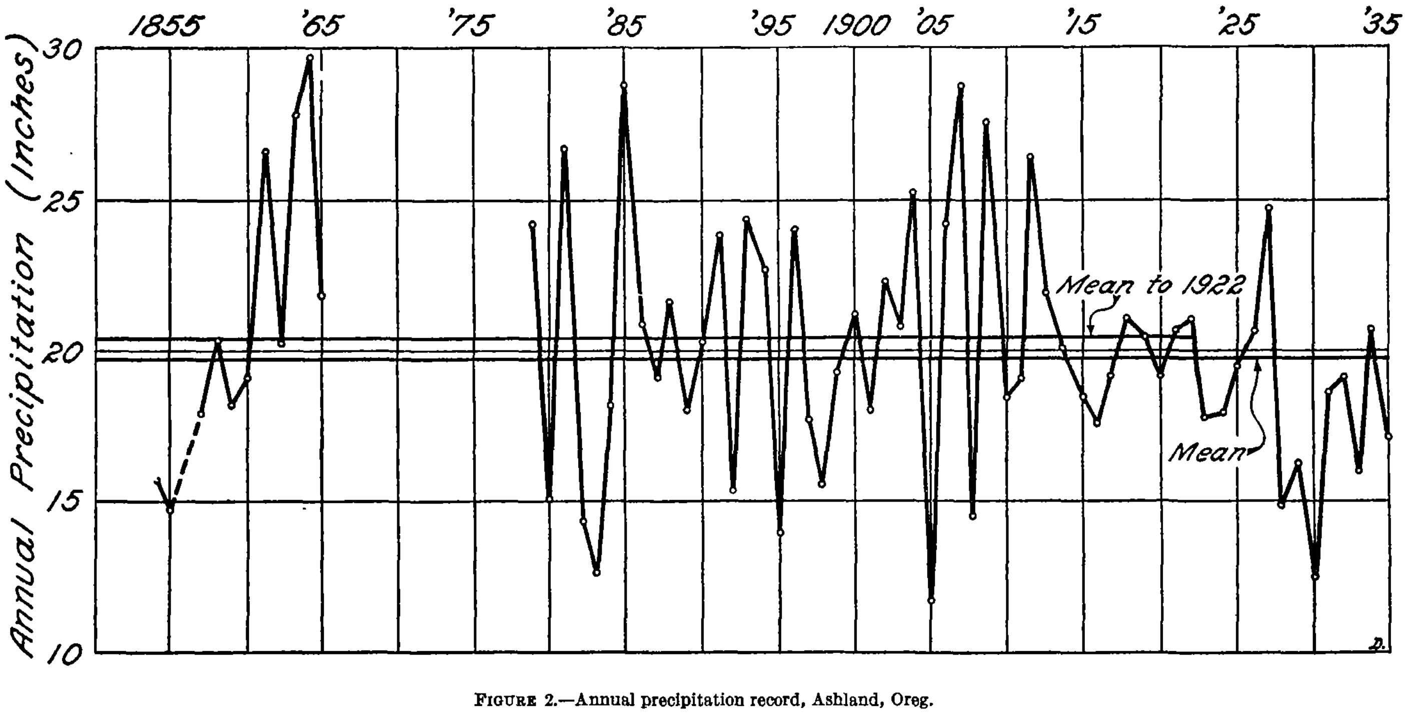

FIGURE 2.—Annual precipitation record, Ashland, Oreg.

trace to 8.10 inches. Such fluctuations mean that the rainfall is not dependable for ordinary types of agriculture. Under natural conditions the Rogue River Valley would be an area of agricultural risk. With this variability of rainfall, together with a low average total and an unfavorable seasonal distribution, it is easy to see why the agricultural specialization of the valley has awaited the development of irrigation.

A third type of rainfall variability may also be demonstrated from the Ashland records. Examination of the yearly precipitation curve since 1879, and the fragmentary private record from 1854 to 1865, shows considerable oscillation. It is also noticeable that these oscillations rise to definite crests. One such crest seems to be indicated around 1864, another between 1880 and 1885, and still another from 1905 to 1910. The average time lapse between these peaks is roughly 22 or 23 years. Apparently this represents a rough pulsation of rainfall. Climatologists are inclined to discredit claims of fixed and definitely recurring climatic cycles, but a pulsatory tendency is frequently evident. While these pulsations do not occur with mathematical frequency, they may form the basis for a certain amount of prediction or expectation. It is evident that a drought period reached its trough about 1930. Since 1930 the trend has been somewhat upward, with slight drops in 1933 and 1935 as is to be expected because of the high annual oscillation characteristic of the valley. During the past two decades, 14 years have been definitely below the mean and only 2 have been definitely above. Hence it may perhaps be expected that the next 5 to 10 years will average an inch or two more rainfall than the last 10 years have. As it stands now, the mean for the official 44-year record for Ashland ending in 1922, and contained in the old section 17 of the Summary of Climatological Data for the United States, is indicated as 20.35. In 1935 that mean stood lowered to 19.75 inches of rain.

If such an increase occurs, it may aid in bringing on generally improved economic conditions for the valley, as it was probably no accident of history that the upswing of the last rainfall crest, 1905 to 1910, saw the greatest increase in population in the history of the valley. This will not mean that irrigation will be less depended upon, as extreme oscillations in annual amount are likely still to take place during a series of heavier rainfall years. The greatest benefit will accrue through a lessened cost for irrigation water on an average, an increase in good pasture land and a restoration of ground-water supplies both for dry and subirrigated farming in the lowlands and in the natural water-storage reservoirs in the uplands.

How may these precipitation variations be accounted for? It would appear that they are closely related to migrations of the prevailing paths of cyclonic and anticyclonic storms. The winter cyclonic path ordinarily passes just north of the Rogue River region. However, cyclonic and anticyclonic storms seldom follow one another in identical paths. Oscillation is much more characteristic of their behavior. In plains areas it is probable that deviations may make little difference; but in a narrow valley embedded 2,000 to 3,000 feet below the surrounding country, the very hearts of these storms must pass through, or else the meteorological effect may be almost entirely nullified, as there are mountain barriers casting a rain shadow from any direction.

GALL'S PROJECTION FOR WORLD MAPS

By I. R. TANNEHILL and EDGAR W. WOOLARD

[Weather Bureau, Washington, September 1936]

The properties of the projection on which any given map is constructed are often of considerable interest and importance in connection with the purposes for which the map is to be used; it is always desirable, and in many cases essential, that these properties be known. Hence the particular projection that has been employed should be specifically stated on the map, as it may be difficult or impossible of identification with certainty from mere inspection. It is a somewhat curious fact that one of the most widely used of map projections, particularly in meteorology, and the one that has long been the principal world base used by the United States Weather Bureau—viz, Gall's projection for world maps, figure 1—has seldom been thus explicitly designated, and must often have been mistaken for Mercator's projection, figure 2, to which it is superficially very similar.

Gall's projection was devised by the Reverend James Gall, of Edinburgh, and first presented by him in 1855, before the British Association for the Advancement of Science. It has received little recognition in formal treatises on map projections, probably for reasons indicated by the following comments of Deetz and Adams, who mention the projection but do not describe or figure it: [1]

> Two projections of the sphere that are found in some atlases, as giving a fair representation of the world, are the Van der Grinten projection and Gall's projection. These two projections are neither conformal nor equal-area and may be classed as intermediates, having no properties of definite scientific value. They present a fair uniformity in the configuration of the world, avoiding the excessive scale increments of the Mercator in the higher latitudes and lessening the distortions of equal-area projections. Their utility nevertheless is pictorial and their practical importance is limited.

A satisfactory cartographic representation of the entire globe presents even greater difficulties than that of only a more or less limited portion of the earth's surface; and it cannot be expected that any one projection can be found which will adequately serve all purposes. The choice of a projection must depend in each case on the particular needs at hand. A cylindrical projection has many advantages for world maps, and this fact has led to an extensive use of the Mercator projection for world maps for all purposes; this projection, however, was designed primarily for use in navigation, and although it is so perfectly adapted to nautical needs as to be *indispensable* to the mariner, it has notable defects for many general purposes, even though it can never be entirely displaced by any other projections.[2]

Gall was led to devise his projection while constructing maps of the constellations for a celestial atlas. In his own words: [3]

> Having occasion to publish an "Atlas of the Stars", I was anxious to produce a panoramic view of the equatorial heavens, extending as far northward as possible; and my object was, of course, to conserve the appearance of the constellations both in regard to form and comparative area. I first attempted Mercator's projection, but the result was not satisfactory: the orientation, indeed, was perfect, but everything else was sacrificed. It then occurred to me that if, instead of rectifying the latitude to the longitude through-

[1] C. H. Deetz and O. S. Adams, Elements of Map Projection, U. S. Coast and Geodetic Survey, Sp. Pub. 68, 4 ed., p. 182. Washington, 1934.

[2] *Cf.* Deetz and Adams, *op. cit.*, pp. 146-147, 101-104, and 34-35.

[3] James Gall: On a new projection for a map of the world, Proc. Roy. Geographical Soc., 15: 159, 1870. This paper includes a plate showing the projection.